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LISTS OF SPECIES

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Arachnids from Araripe Plateau, Ceará, Brazil

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Abstract: The Araripe Plateau is situated in the states of Ceará, Piauí and Pernambuco, northeastern Brazil, in the Caatinga biome, semiarid domain. This region of Brazil is characterized by high temperatures and low rainfall. Nevertheless, due to its high elevation and large amount of orographic rainfall, the Araripe Plateau is an exception as a seasonal semi-deciduous forest with high humidity in the semiarid domain and the Caatinga biome. Herein a species list of Araripe Plateau arachnids is presented from the compilation of data from *in situ* sampling from January to May 2013, from the literature, and from Brazilian arachnid collections data. A total of 68 species were recorded for the area, of which 53 were spiders, eight harvestmen and seven scorpions. The species richness recorded here is considered significant regarding the known diversity of Arachnida in the semiarid region and contributes to expanding our knowledge of the area.

Key words: Arachnida; Araneae; Scorpiones; Opiliones; Caatinga

INTRODUCTION

The Caatinga biome is one of the least studied Neotropical biomes (Leal et al. 2005; Santos et al. 2011), with current data suggesting that about 41% of the area has never been surveyed by scientists and 80% has been poorly sampled (Tabarelli and Vicente 2004). This situation is even worse for taxa such as invertebrates (Lewinson et al. 2005). Among arachnids, recent estimates indicate that there are no records of spiders (Carvalho et al. 2014) or scorpions (Porto et al. 2014) for about 70% of the Caatinga area.

Even considering such heterogeneous sampling, presently there are 271 spiders (Carvalho et al. 2014), 28 scorpions (Porto et al. 2014) and 28 Laniatores harvestmen (De Souza et al. 2014) species recorded for the Caatinga biome. These numbers represent about 8.5%, 21% and 5%, respectively, of the spiders, scorpions and Laniatores harvestmen species recorded in Brazil (Carvalho et al. 2014; Porto et al. 2014; De Souza et al. 2014). The potential explanations for these numbers are different for each group. Considering that the Caatinga occupies about 10% of Brazilian territory, the number of spider species might represent a clear effect of sampling deficiency, as it is lower than expected by chance (Carvalho et al. 2014). The scorpion species richness in the Caatinga is higher than expected by chance. However, considering that the world's highest scorpion species richness (4–13 sympatric species at one site) occurs in drier areas (Polis 1990), more scorpion species would be expected to be found in the Caatinga. On the other hand, for harvestmen, the low species richness in the Caatinga biome was expected, as many species are ineffective at preventing water loss (Santos 2007a), thus resulting in higher species richness in humid areas throughout Brazil, such as the Atlantic Forest (Pinto-da-Rocha et al. 2005).

In the present paper, we present a list of the spiders, scorpions and harvestmen from the Araripe Plateau, northeastern Brazil. The arachnid fauna of the area has been the focus of only a few published papers, mainly consisting of the description of fossil (i.e., Campos 1986; De Carvalho and Lourenço 2001; Selden et al. 2006) or living taxa (i.e., Bonaldo and Brescovit 1998; Corronca 1998; Rheims and Brescovit 2004; Lourenço 2010, 2014; Ruiz 2013; Huber et al. 2014). None of these publications directly dealt with the Araripe Plateau arachnid fauna, but focused on taxonomic issues rather than providing species lists. The present paper is the first to compile published records and new records gathered from field work into a species list for the area.

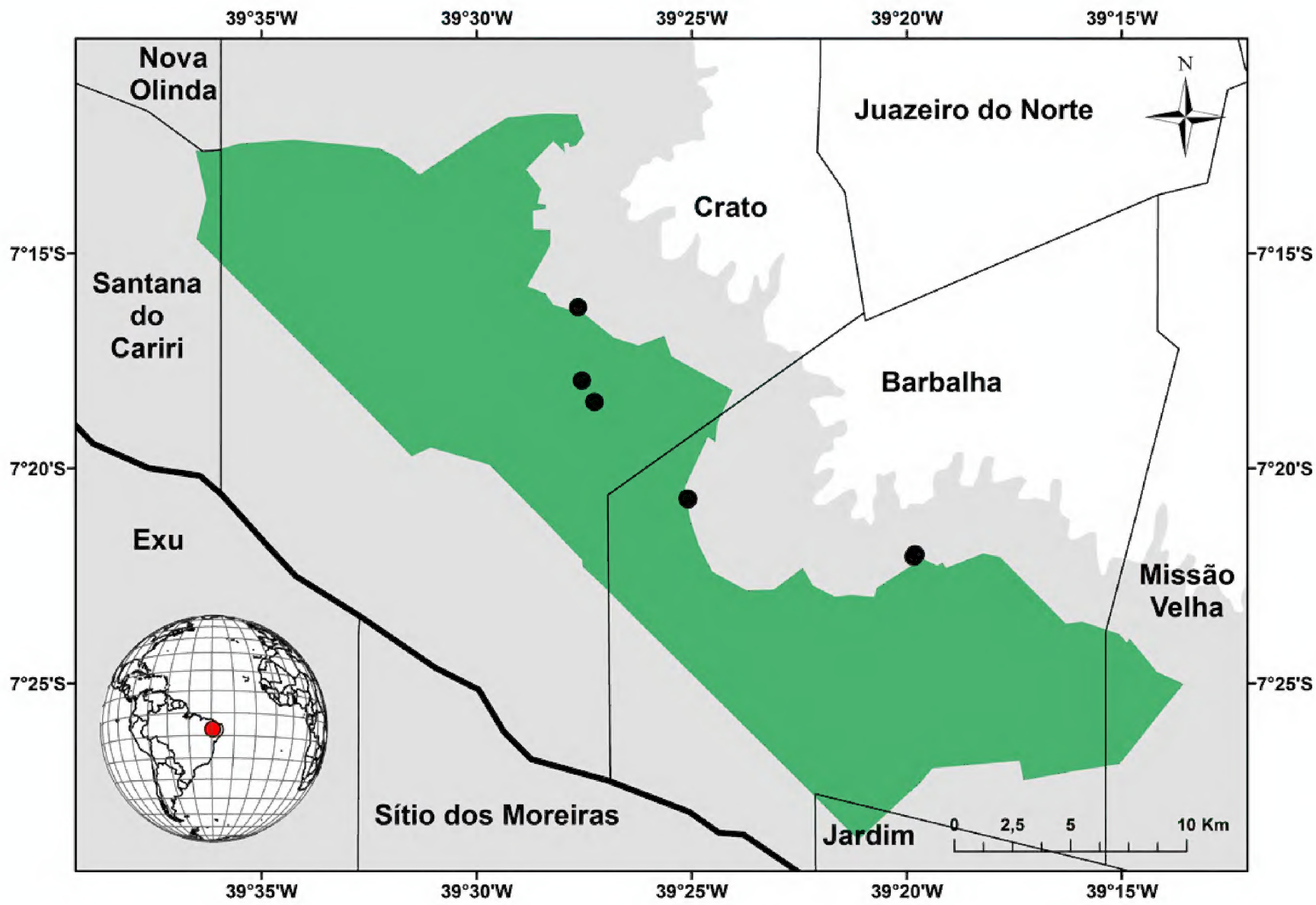

Figure 1. Map of the sampled localities (black dots) and its location in the Araripe National Forest (in green) and the Araripe Plateau (in grey). Municipalities below the thick line are located in the State of Pernambuco, and those above are located in the State of Ceará.

MATERIALS AND METHODS

Study area

The Araripe Plateau is located in northeastern Brazil, in the states of Ceará, Piauí and Pernambuco. It includes the Araripe National Forest (Floresta Nacional do Araripe, 07°20′42″ S, 039°25′6″ W). The region is within the Caatinga biome, a warm (mean annual temperature 26°C – 28°C; Nimer 1972) semiarid biome. Despite the dry and warm environment, the high elevation of the region (more than 500 m above sea level), contributes to the production of approximately 1,200 mm of orographic rainfall (Andrade-Lima 1982; Prado 2003; Leal et al. 2005). This allows the formation of forested enclaves on the windward slopes of hills, known as "brejo-de-altitude" (Prado 2003; Leal et al. 2005).

Data collection

Since 2010, occasional arachnid surveys have been carried out by various researchers in several localities, both inside and outside the Floresta Nacional do Araripe, such as the municipalities of Crato, Juazeiro do Norte and Barbalha, state of Ceará, (Figure 1). The sampling points map (Figure 1) was constructed using ArcGis 10.3 software (ESRI 2015).

The arachnids were sampled using three techniques: pit-fall traps for invertebrates (500 ml plastic buckets buried at ground level, with 70% ethanol as preservative, placed at least 5 m apart and kept open for at least five consecutive days), diurnal and nocturnal hand searches (with and without UV lamps) and litter sampling (1 m^2 of litter sifted and hand sorted in each sample). All standardized samplings followed usual arachnid sampling methods, as described in Carvalho (2015). The species were identified using keys for spiders (Levi 1968, 1991, 1997, 2004; Corronca 1998; Bonaldo 2000; Brescovit and Rheims 2000; Rheims and Brescovit 2004; Santos 2007b; Abrahim et al. 2012), scorpions (Lourenço 2002; De Souza et al 2009) and harvestmen (Pinto-da-Rocha 1997) and by comparison with identified material deposited in institutional collections.

Collected specimens were deposited in the following collections: Museu Paraense Emílio Goeldi, Belém, Pará (MPEG; curator A.B. Bonaldo); Instituto Butantan, São Paulo, São Paulo (IBSP; curator A.D. Brescovit); Universidade Federal de Minas Gerais, Belo Horizonte, Minas Gerais (UFMG; curator A.J. Santos); Coleção de História Natural da Universidade Federal do Piauí (CHNUFPI; curator E.F.B. Lima); Universidade Federal da Paraíba, João Pessoa, Paraíba (UFPB; curator M.B. da Silva) and Museu Nacional do Rio de Janeiro, Rio de Janeiro, Rio de Janeiro (MNRJ; curator A.B. Kury).

The species list herein also includes information gathered from previous publications on arachnids of the Araripe plateau: Bonaldo and Brescovit (1998), Corronca (1998), Lourenço (2010, 2014), Lourenço et al. (2013), Maury (1982), Rheims and Brescovit (2004), Ruiz (2013) and Huber et al. (2014).

RESULTS

The compiled list includes 68 arachnid species, represented by 53 spider, seven scorpions and eight harvestmen species (Table 1). Thirty-five species were identified to species level and six undescribed species were recognized, belonging to the genera *Orthonops* Chamberlin, 1924 (Caponiidae), *Corinna* C. L. Koch, 1841 (Corinnidae), *Neodrassex* Ott, 2012 (Gnaphosidae), *Otiothops* MacLeay, 1839 (Palpimanidae), *Ariadna* Audouin, 1826 (Segestriidae) and *Tenedos* O. Pickard-Cambridge, 1897 (Zodariidae). The spider family Corinnidae and scorpion family Buthidae presented the highest species richness.

Table 1. Spider, scorpion and harvestman species list from the Araripe Plateau, Ceará, Brazil, with the number of specimens collected and source of information gathered.

Taxa	Total	Species collected in this study	Specimens from museums or cited in the literature
ARANEAE			
Araneidae			
Araneus venatrix (C. L. Koch, 1838)	1	MPEG 024478	
Aculepeira cf. travassosi (Soares & Camargo, 1948)	1	CHNUFPI 1203	
Araneus guttatus (Keyserling, 1865)	2	CHNUFPI 1205, 1225	
Argiope argentata (Fabricius, 1775)	1	CHNUFPI 1210	
Kapogea cyrtophoroides (F. O. Pickard-Cambridge, 1904)	1	CHNUFPI 1219	
Caponiidae			
Orthonops sp. n. 1	2	MPEG 24475, 024476	
Corinnidae			
Corinna gr. aenea sp. n. 2	3	CHNUFPI 0102, 0127, 0136	
Corinna gr. capito sp. 1	1	CHNUFPI 0119	
Falconina gracilis (Keyserling, 1891)	2	MPEG 024479, 024480	
Abapeba gr. *abalosi* (Mello-Leitão, 1942)	2	MPEG 024437, 024438	
Attacobius verhaaghi Bonaldo & Brescovit, 1998	1		Bonaldo and Brescovit (1998)
Corinna sp. 1	3	MPEG 024447, 024448, 024449,	
Mazax sp. 1	4	MPEG 024433, CHNUFPI 0113	
Castianeira sp. 1	1	MPEG 024435	
Castianeira sp. 2	1	MPEG 024432	
Corinninae sp. 1	1	CHNUFPI 0092	
Castianeirinae sp. 1	1	MPEG 024434	
Ctenidae			
Ctenus sp. 1	1	CHNUFPI 1217, 1224	
Cyrtaucheniidae			
Fufius sp. 1	1	CHNUFPI 1218	
Dictynidae			
Dictyna sp. 1	1	CHNUFPI 1211	
Deinopidae			
Deinopis sp. 1	2	CHNUFPI 1081	
Gnaphosidae			
Gnaphosidae sp. 1	1	MPEG 024472	
Neodrassex sp. n. 1	1	MPEG 024470	
Hahniidae			
Hahniidae sp. 1	1	MPEG 024450	
Hersillidae			
Ypypuera crucifera (Vellard,1924)	2	CHNUFPI 0435	Rheims & Brescovit (2004)
Linyphiidae			
Agyneta sp. 1	4	CHNUFPI 1215, 1220,1221, 1223	
Oonopidae			
Gamasomorpha lutzi (Petrunkevitch, 1929)	2	MPEG 024445, 024446	
Neoxyphinus termitophilus (Bristowe, 1938)	3	MPEG 024467, 024468, 024469	
Nephilidae			
Nephila clavipes (Linnaeus, 1767)	1	CHNUFPI 1208	
Palpimanidae			
Otiothops sp. n. 1	2	MPEG 024474, 024471, 024477	
Pisauridae			
Architis tenuis Simon, 1898	7	CHNUFPI 1200, 1214, 1222	
Phrurolithidae			
Orthobula sp. 1	1	CHNUFPI 0103, 0141	
Orthobula sp. 2	1	CHNUFPI 0079, 0113, 0091	

Continued

Table 1. *Continued.*

Taxa	Total	Species collected in this study	Specimens from museums or cited in the literature
Pholcidae			
Micropholcus crato Huber, Carvalho & Benjamin, 2014	4		Huber et al. (2014)
Salticidae			
Soesilarishius macrochelis Ruiz, 2013	1	MPEG 20278	
Soesilarishius cearensis Ruiz, 2013	1	MPEG 20293	
Scytodidae			
Scytodes eleonorae Rheims & Brescovit, 2001	3	CHNUFPI 0468, 0471, 0472	
Segestriidae			
Ariadna sp. n. 1	2	CHNUFPI 0247, 0248	
Selenopidae			
Selenops maranhensis Mello-Leitão, 1918	2		Corronca (1998)
Senoculidae			
Senoculus sp. 1	1	CHNUFPI 0424	
Sicariidae			
Loxosceles amazonica Gertsch, 1967	1		UFMG 12064
Sicarius cariri Magalhães, Brescovit & Santos, 2013	4	CHNUFPI 0071	IBSP 9142, UFMG 11690, 11691
Tetragnathidae			
Chrysometa sp. 1	1	CHNUFPI 1201	
Leucauge sp. 1	1	CHNUFPI 1204	
Leucauge sp. 2	1	CHNUFPI 1212	
Theridiidae			
Chrosiothes sp. 1	2	MPEG 024442, 024443	
cf. *Theridion* sp. 1	1	CHNUFPI 1213	
Theridiidae sp. 1	2	MPEG 024441	
Theridiidae sp. 2	1	MPEG 024444	
Thomisidae			
Bucranium taurifrons (O. P.-Cambridge, 1881)	1	MPEG 024451	
Zodariidae			
Leprolochus mucuge Lise, 1994	42	MPEG 024452, 024453, 024454, 024455, 024456, 024457, 024458, 024459, 024460, 024461, 024462, 024463, 024464, 024465, 024466	
Leprolochus oeiras Lise, 1994	5	MPEG 024439, 024440	
Tenedos sp. n. 1	1	MPEG 024473, 024473	
SCORPIONES			
Bothriuridae			
Bothriurus rochai Mello-Leitão, 1932	1		Maury (1982)
Chactidae			
Hadrurochactas araripe Lourenço, 2010	1		Lourenço (2010)
Buthidae			
Ananteris franckei Lourenço, 1982	11	CHNUFPI 1206, 1207, 1227	Lourenço et al. (2013)
Tityus martinpaechi Lourenço, 2001	1		UFMG 12534
Tityus stigmurus (Thorell, 1877)	8	CHNUFPI 0902, 0908, 0911, 0917, 0921, 1216,1226	UFMG 12533, IBSP 3841
Rhopalurus agamemnon (C.L. Koch, 1839)	1		IBSP 816
Rhopalurus brejo Lourenço, 2014	1		Lourenço (2014)
OPILIONES			
Escadabiidae			
Escadabiidae sp. 1	1		MNRJ 02121
Cosmetidae			
Eupoecilaema megaypsilon (Piza, 1938)	3		UFPB 251
Gonyleptidae			
Pseudopucrolia discrepans (Roewer, 1943)	2		MNRJ 04683, UFPB 255
Parapachyloides uncinatus (Søerensen, 1879)	3		MNRJ 17474, UFPB 253
Sclerosomatidae			
Munequita sp. 1	2		UFPB 254
Stygnidae			
Stygnus polyacanthus (Mello-Leitão, 1923)	1		UFPB 252
Protimesius sp. 1	1		MNRJ 05272
Zalmoxidae			
Zalmoxidae sp. 1	1		MNRJ 02123

DISCUSSION

Attacobius verhaaghi Bonaldo & Brescovit, 1998 (Corinnidae), *Selenops maranhensis* Mello-Leitão, 1918 (Selenopidae), *Bothriurus rochai* Mello-Leitão, 1932 (Bothriuridae), *Hadrurochactas araripe* Lourenço, 2010 (Chactidae), and *Rhopalurus brejo* Lourenço, 2014 (Buthidae) have been reported from the Araripe Plateau only from literature records, respectively by Bonaldo and Brescovit (1998), Corronca (1998), Maury (1982), and Lourenço (2010, 2014). *Rhopalurus agamemnon* (C.L. Koch, 1839) is recorded for the Araripe Plateau by a single specimen in the IBSP collection (Table 1). *Selenops maranhensis*, *B. rochai* and *R. agamemnom* are widespread species (Corronca 1998; Lourenço 2002) and their absence from our sampling is attributed to sampling bias. Conversely, *A. verhaaghi* is rare in spider samplings, because most species of the Attacobiini (a tribe of Corinnidae) are ant-clinging spiders and are expected to live near ant nests, where spider samplings were rarely performed. The buthid scorpions *R. brejo* and *H. araripe* are both recorded from Araripe based on specimens whose precise type localities and preferable microhabitat are unknown (Lourenço 2010, 2014).

Among the arachnids collected, 22 species were

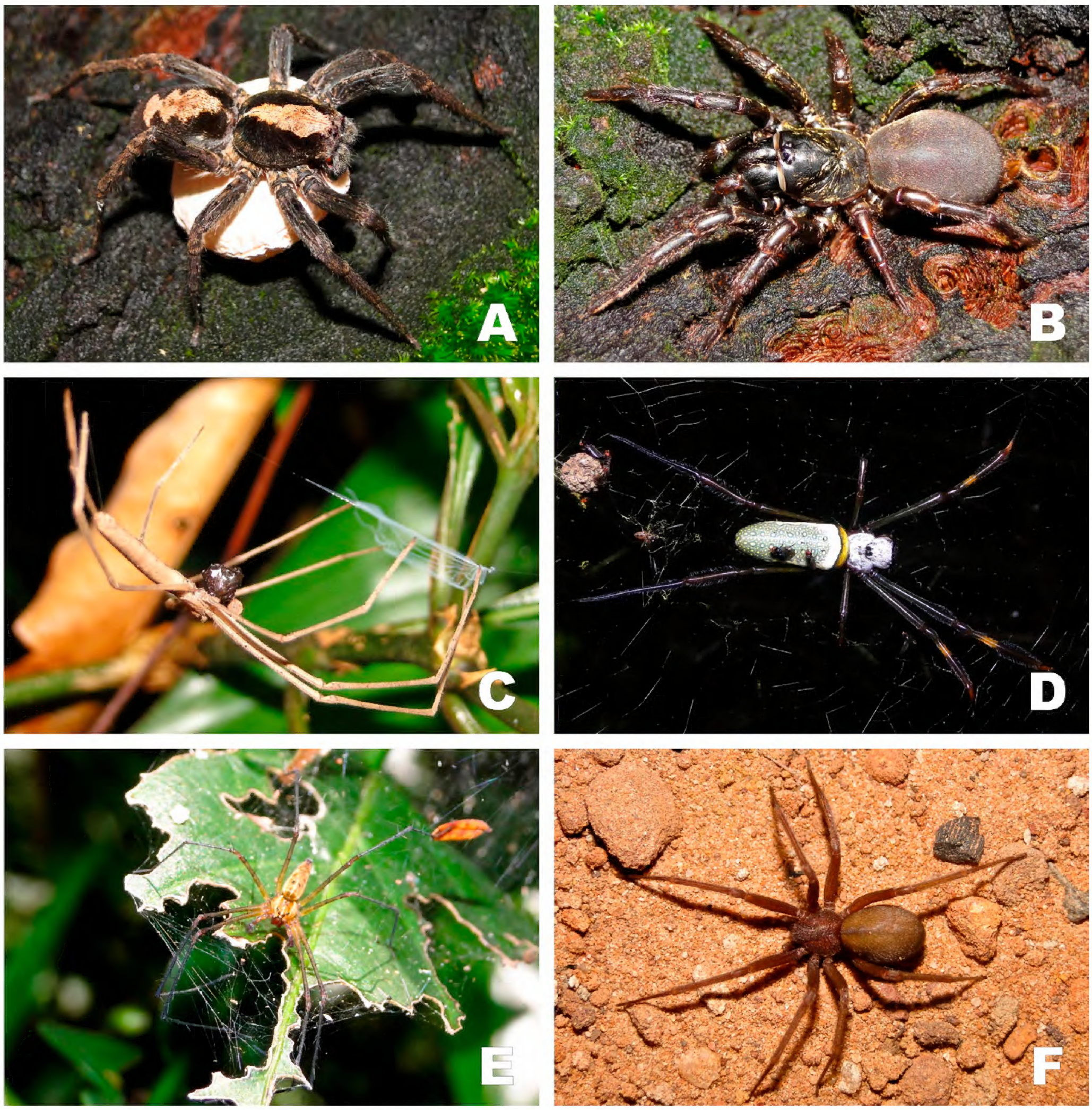

Figure 2. Representatives of the spiders from the Araripe Plateau, Ceará, Brazil. **A:** Ctenidae, *Ctenus* sp.1, female carrying egg-sac; **B:** Cyrtaucheniidae, *Fufius* sp.1; **C:** Deinopidae, *Deinopis* sp.1; **D:** Nephilidae, *Nephila clavipes*, female with kleptoparasitic flies; **E:** Pisauridae, *Architis tenuis*; **F:** Sicariidae, *Loxosceles amazonica*. Photos: L.S. Carvalho.

identified, most of them widespread in the region (e.g., *Ypypuera crucifera* (Vellard, 1924), *Neoxyphinus termitophilus* (Bristowe, 1938), *Architis tenuis* Simon, 1898, *Tityus stigmurus* (Thorell, 1877); Rheims and Brescovit, 2004; Santos 2007b; De Souza et al. 2009; Abrahim et al. 2012). Some of the collected species are commonly observed in synanthropic environments, such as *Scytodes eleonorae* Rheims & Brescovit, 2001, *Loxosceles amazonica* Gertsch, 1967 (Figure 2F) and *Argiope argentata* (Fabricius, 1775) (Lucas et al. 1986; Rheims and Brescovit 2001; Levi 2004). On the other hand, *Ananteris franckei* Lourenço, 1982 (Figure 3B), *Micropholcus crato* Huber, Carvalho & Benjamin, 2014, *Soesilarishius macrochelis* Ruiz, 2013 and *Soesilarishius cearensis* Ruiz, 2013 are known only from the Araripe Plateau (Lourenço 2002, 2004; Ruiz 2013; Huber et al. 2014; Porto et al. 2014). These last four species must be considered endemic to the Araripe rainforest, as no further record of them outside that area are known (Giupponi et al. 2009, Lourenço 2012, 2013; Ruiz 2013; Huber et al. 2014).

The Araripe Plateau constitutes a natural forested enclave (Prado 2003; Leal et al. 2005), also known as "brejo-de-altitude" (Andrade-Lima 1982). The fauna

Figure 3. Representatives of the scorpions and harvestmen from the Araripe Plateau, Ceará, Brazil. **A:** Bothriuridae, *Bothriurus rochai*; **B:** Buthidae, *Ananteris franckei*; **C:** Buthidae, *Tityus martinpaechi*; **D:** Buthidae, *Tityus stigmurus*; **E:** Cosmetidae, *Eupoecilema megaypsilon*; **F:** Gonyleptidae, *Parapachyloides uncinatus*. Photos: L.S. Carvalho.

and flora of these areas are different from the typical Caatinga environment and usually exhibit a trend toward high diversity (Werneck 2011). These warmer environmental conditions are also more suitable for a myriad of arachnid species which are absent from the arid environment surrounding the forested area, such as harvestmen (Curtis and Machado 2007), which prefer more humid environments (Santos 2007a; De Souza et al. 2014).

The harvestmen fauna of the Araripe Plateau is composed of eight species, a species richness that falls within the expected number for Brazilian open biomes (Bragagnolo and Pinto-da-Rocha 2003; Pinto-da-Rocha et al. 2005). However, the harvestmen community is composed of a mixture of taxa typical of different environments. *Pseudopucrolia discrepans* (Roewer, 1943) is usually found in forested enclaves in northeastern Brazil and in the Atlantic Forest in Paraíba and Parnambuco (Mendes 2011). *Parapachyloides uncinatus* (Soerensen, 1879) (Figure 3) is widely distributed throughout the Cerrado and Caatinga biomes (Kury et al. 2010), mostly associated with more humid areas (pers. obs.). Conversely, *Stygnus polyacanthus* (Mello-Leitão, 1923) is widely distributed in northeastern Brazil, often occurring in drier areas, where it can be found under termite nests or fallen trunks (Pinto-da-Rocha 1997; Pinto-da-Rocha and Carvalho 2009).

This work constitutes the first species list of arachnids for Araripe Plateau. Although the number of identified species or the total species richness is not especially high, the records herein presented are important as they fill a gap in the known geographical distribution of many arachnid species in the Caatinga biome. These records are important data for proposing and delimiting areas of endemism (see Oliveira et al. 2015), one of the most important tools for selecting priority areas for conservation. This list is also a first step for further ecological and taxonomical investigation on the arachnids of the region. The huge Wallacean shortfall related to invertebrates from the Caatinga biome prevents the proposition of such wide studies, while with plants, for example, Caatinga ecoregions were proposed more than a decade ago (Velloso et al. 2002). Thus, it is expected that with the increase in number of published papers on arthropod geographical distribution, species inventories and new records from the Caatinga, more ecological, taxonomic and biogeographic studies can be conducted.

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